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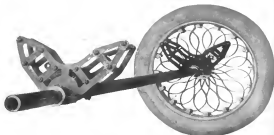
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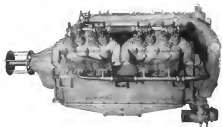
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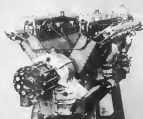
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No. 6

Means of Obtaining High Volumetric Efficiency for Aviation Engines

Although it is at the present time impossible to give any definite rules and regulations as regard to design of valves, intake and exhaust ports of airplane engines, a few general ones may be stated which have been found during the latest experiments in this country and abroad.

The one and most important point in the design of airplane engines is the matter of reducing the weight of the engine or developed horsepower, without sacrificing the factor of safety and the reliability of the different parts of the engine. It is general it can be said that the weight of a number of parts of an engine is in a certain degree independent of the horsepower developed by the engine. This means that the same parts will work on water pump and compressors, engines

This development means, however, recently to have received somewhat of a setback by reason of the development of an air propeller that would give satisfactory efficiency at as high as 1700 rpm. It is generally found in comparing a geared cylinder engine, running at 2100 rpm with an engine of same cylinder dimensions and valve construction but running on a straight drive at 2700 rpm, that the weight of the gears offsets the increased power output, due to the increased engine revolutions, and that the total horsepower per pound becomes approximately the same in both cases, and the less complicated straight drive engine is usually preferred. A further example of this can be found in the same engine mentioned above. This engine has been developed to run 1350 rpm in straight drive,



Fig. 1



Fig. 2



Fig. 3

compressors and turbosuperchargers, lower part of crank pin or of shaft, etc. In this way, the developed power of an engine can be increased without adding more cylinders or changing the dimensions of the cylinders, and simply increasing the weight of such parts which are subjected to the additional strain, such as connecting rods, crankshaft, wristpins, etc. It is obvious that a material gain in horsepower per lb. engine weight may be obtained.

Increased developed horsepower without changing the cylinder dimensions can be obtained in two ways, either by increasing the revolutions per min. of the engine, or by increasing the mean effective pressure in the cylinder, or again, a combination of both.

It was not found advisable from the early days of the aviation engine until the last year, to run the engines over 1400 rpm, due to the fact that the stoppage of the air propeller would become so great at speeds above 1400 rpm that no in-flight practice could be obtained. In order to maintain a cylinder speed of 1400 rpm, and still obtain the increased efficiency of the higher speed engine, the development of the supercharger device came into being. Several successful types of these engines have been put on the market during the past year and provide as much more response to the straight drive engine running at 1400 rpm, as that they are somewhat higher per horsepower.

In an interesting comparison between two engines of about the same size as is indicated on the foreign design, this engine was built as a straight drive engine requiring 1400 rpm, and the other as a geared engine requiring 2100 rpm. The same engine was later built to run 2800 rpm with a geared propeller shaft running 1500 rpm, and with the same cylinder dimensions the weight decreased to 2.4 lb. per horse-

power and found to develop one horsepower per 2.4 lb. engine weight.

The only remaining points of increasing the developed horsepower without increasing the cylinder dimensions or the number of cylinders is, therefore, to increase the explosion pressure, or mean effective pressure by increasing the charge of gas into each cylinder. The effect of the compression ratio has not been given any consideration is shown, due to the fact that in general present day gasoline the compression ratio has been brought up to the limit of what can be used in practice. A compression ratio of 16.5 per cent to 17 per cent is all that can be used, and an engine with this compression ratio cannot run with wide open throttle under full load on the ground for more than 10 to 15 min. at a time without requiring unnecessary damage to the crankshaft bearings, due to excessive vibration. Such an engine is generally tested and used on the ground up to 75 per cent of full load, the remaining power being used only when the airplane is in which the engine is mounted has reached an altitude where the lower air pressure reduces the compression so much that the engine will run safely at full open throttle.

It can be seen from the above that an additional power output can be obtained by increasing the compression ratio once the maximum practical compression ratio has been reached, and that designers of aviation engines have only the increase in effective pressure, built as a means of obtaining higher output per pound weight.

The ways of increasing the charge of fuel in the cylinders for such engines can be divided into two classes, the normal intake where the downward stroke of the piston creates the vacuum necessary to fill the cylinder with gas, and the forced intake, where by some means the charge is forced in under pressure.

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draws the mixture into the cylinder is determined not only the piston speed and displacement are determined, and the charge can only be increased by decreasing the resistance which the incoming charge meets on its way from the carburetor to the cylinder head.

The piston will make several conditions power draw as much charge per action stroke as is represented by the piston displacement volume at atmospheric pressure, and temperature. The volume of charge drawn will vary with the engine speed and temperature and will at a low engine decrease at first rapidly with increasing speeds, then less rapidly, and becomes constant or increases at speeds of 1200 to 1800 r.p.m. The ratio of the

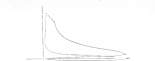


Fig. 4

charge drawn is compared with the volume displaced by the piston will vary from 10 to 50 per cent.

The first question that arises here is the question of number of valves per cylinder, whether two, three or four valves are preferred. The consideration that will give the best design for the intake valve is the most desirable, and will produce the most power, and this is generally obtained by using two intake valves per cylinder. It depends, however, upon the shape of the cylinder head and the location of the valves and must be decided at each case.

The lower weight of the smaller valves will allow a lighter and more readily opening and closing of the valve due to less springing weight and thus allow the diameter of the opening of the valves to be increased to the limit. As a matter of strength the smaller valves offer better advantage due to the lower weight and smaller springs. The disadvantage of the two valves per cylinder lies in the comparison in the system of intake and exhaust valves, which are, however, to be somewhat offset by using flared intake valves so that both valves are assisted by the same area and the same pressure.

The question of exhaust valves is somewhat different. The main point here is not to avoid resistance in the expansion of the burnt gases, so there are not driven by a vacuum, but by a positive pressure flow, the point of most importance is how to provide sufficient cooling of the lower part of the valve.

The valve is cooled at two points around the seat where the valve is closed and around the stem where it is cooled with the valve guide. Inasmuch as the larger part of the heat is carried out through the stem and the valve guide, provided the guide is properly cooled, it can easily be confirmed that the valve will run cooler when the stem is cooled than when the stem draws the heat so small. This favors also the use of two smaller exhaust valve per cylinder.

Another factor that must be considered in the design of the exhaust valves is the escape of heat. While it is advisable from the point of view of cooling to use a wide seat that will offer a large surface of contact while the valve is closed, such a wide seat is liable to become overheated and cause loss of compression.

A general rule of thumb is to use a seat that where the combustion of exhaust and cylinder head will allow it, it will be found advantageous to use four valves per cylinder.

The general design of the valves has been left unchanged for several years, and it is just recently that the mechanical competition among aviation engine builders has brought out development work along this line. Heretofore, it was and still is many years behind the design of the design of the intake and the exhaust valve alike, so that the valves are interchangeable.

Usually the tendency has, however, been to design the intake valves with more direct regard to the free flow of incoming charge. The most disturbing effect in the distribution of the gas from the carburetor to the cylinder, is the reaction of

valves in the incoming mixture. These offer an appreciable resistance against the free flow of gas. Intake valves in intake parts in the cylinder heads should, therefore, be designed in such a way as to offer the least possible resistance to intake valves. This can be obtained by giving the pump between the valve and the walls of the parts in such a way as to allow the gas to pass, and avoid all sharp projections or sudden changes in the parts.

Intake valves with a cone shaped power port, or wide heavy lift, as shown in Fig. 5, have recently been used by some domestic and foreign engine builders, and give very good results.

Fig. 5 shows an intake port and valve of older design, it can readily be seen that this construction will offer increased resistance in the gas passage and cause valve lift, and as it is important here to measure the length of the lower part of the valve the design as shown in Fig. 5 has been brought out. The rim of the valve is raised into a more uniform surface of the valve in order to give the gas passage from coming into contact with the surface of the valve, and thus heating the lower part of the port of the valve, is partly to resistance and provide more flow to the rim of the valve which is most exposed in the head and most liable to wear.

Another point which has to be borne in mind is the power output of the engine, but which is of vital importance in relation to the engine, is the proper cooling and water jacketing of the exhaust valves and intake valves. Inasmuch as the engine has given more valve travel in the past than any other engine, and the expansion of water cooled valve guides must be compensated. The intake guide should have a water seal all around it and the design of the guide must provide continuous flow of water in the guide, not merely flow in the water jacket which will be of no real value of water seal.

However, no matter how carefully the engine passages and valve designs are made there is always a limit in the rate that can be drawn into the cylinder through normal sized

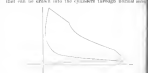


Fig. 5

and in order to further raise the horsepower output of the engine the designer must look toward intake or exhaust valves in the design of the engine.

It has been attempted to supercharge the cylinders in different ways. So far only one has proven successful, and that is to take in a charge of fresh mixture through normal sized valves and then admit fresh air at the bottom of the cylinder strokes under pressure.

To assist the correct mixture under pressure has not been successful, owing to the fact that the positive velocity under pressure and under pressure mixture must be increased in this way. The actual working of the supercharger can be explained as follows: As mentioned above, the supercharger is a device which is used to compress the mixture without exposing parts of the engine to under lift.

The supercharged engine is subjected to the same motion and the compression measured in pounds per square inch is the same as the normal engine. The advantage is, however, obtaining the possibility of using a larger explosion chamber for the same power, and thus giving a larger charge of gas, and thus a larger explosion chamber for the same power.

The effect of this can readily be seen on the sketch of diagram in Fig. 6 and Fig. 7. Fig. 6 shows the design of the explosion stroke of a normal engine. This shows

and shows in profile after the explosion has occurred. In a supercharged engine where a large body of charge is used under the same compression, the initial pressure will be somewhat higher, but the most important point is that the pressure will decrease much more slowly, due to the larger gas volume, the combustion chamber and the increase in the gas volume, the decreased length of the piston. In the work, most of the additional power is obtained after the combustion has taken place, rather than at the moment of the combustion.

The advantage of this is evident, for the piston, without, without, without, etc., are not subjected to a nearly higher initial stress, but rather in a steady draw following after the combustion. In other words, only a slight

Determination of the Moments of Inertia of an Airplane

By John J. Rooney

The aim of the products of the mass of each elementary part of a body and the square of its distance from a given axis is called the moment of inertia of the body about that axis.

In the case of the solid, there are always three principal axes passing through any particular point, about each of which it is necessary to know the moment of inertia.

When the point selected is the center of gravity of the body, the axes are known as the gravity axes. It is the

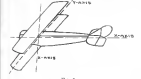


Fig. 3

moment of inertia of the airplane about each gravity axis that is required in stability computations.

The gravity axes of an airplane are usually selected for the purpose of horizontal flight, that is, the longitudinal axis is the plane of symmetry and parallel to the propeller

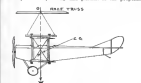


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increase in the dimensions of the whole parts is necessary, and the performance of the engine approaches that of a steam engine in its functioning from the outside. In engine of this type as much as 500 per cent or more increase in horsepower over engines of the same dimensions, but with normal intake, has been obtained.

It is furthermore possible with supercharged engines to vary the compression with very simple mechanical arrangements, by varying the pressure of the compressed air admitted to the cylinder at the bottom of the intake stroke, so that the correct compression can be maintained at all altitudes to which the airplane may ascend. The present development seems to indicate strongly that the future of the aviation engine belongs to the supercharged type engine.

Method of Finding the Center of Gravity

As the center of gravity of a well designed airplane is in the plane of symmetry, it is not necessary to determine the x and y coordinates from fixed reference points in the plane to know its position.

(a) x -Coordinate.—This coordinate which is measured along the x -axis from the reference point to the center of gravity, is determined by weighing the airplane on two platforms scales placed under its nose and tail, observing the separate weights, and measuring the distance between the points of support, then taking moments about one of the points.

(b) z -Coordinate.—As the magnitude of determining the moments of inertia to be described requires the airplane to

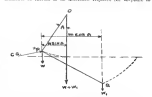


Fig. 7

be suspended from a point so that it is free to oscillate as a compound pendulum, the z -coordinate is determined by a method which makes use of the same suspension.

The airplane is then suspended with the x -axis horizontal from a point in the z -axis some distance above the top wing, as shown in Fig. 7, then deflected through an angle by means of a known weight, attached to the tail at a known distance from the z -axis, as shown diagrammatically in Fig. 8.

Then if W = weight of airplane;
 W_P = weight added on tail;

OP = a , unknown distance measured along z -axis from point of suspension to the center of gravity;

OP = b , known distance measured along same axis from z -axis to point of attachment of W_P ;

θ = angle through which airplane is deflected.

By taking moments about P , we have:

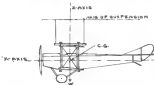
$b = W_P \sin \theta + (W - W_P) \sin \theta$ (1)

In using this method it is advisable to make θ as large as possible and thereby minimize errors. In measuring the angle

a plumb bob with a steel cord about 35 in. long should be attached to the body and a mark made at as large a radius as possible for each position of the airplane. As it may be necessary to know the angle in leveling, it should be determined from its tangent and not measured with a protractor.

Methods of Finding Moments of Inertia About Centroid Axis

(a) *About x-axis*—The airplane is suspended in a suitable frame by means of two cables in its plane of symmetry placed equal distances on each side of the center of gravity, as shown in side view of Fig. 4.



Side View, Fig. 4

It is essential in making this determination that the air plane oscillate as a rigid body about its axis of suspension and that all secondary vibrations about other axes be eliminated. This condition may be brought about by running steel wires from the points of suspension to the wing tips, as shown in front view, Fig. 4. The airplane by a slight twist on the wing tip will now oscillate as prescribed.

Then if I = moment of inertia in (lb. ft.²) of airplane about its x-axis,

h = radius of gyration in ft.,

g = acceleration of gravity 32.2 ft. per sec.

k = distance in feet from the axis of suspension of the airplane to its center of gravity;

n = number of complete vibrations per min.,

W = weight of airplane in pounds.



Front View, Fig. 4

$$K = \sqrt{\frac{2k \cdot 160^2}{4\pi^2 n^2}} = K' \quad (1)$$

$$I = K' W \quad (2)$$

No vibration should be measured while the airplane is large, and a stop watch should be used for timing.

(b) *About y-axis*—The airplane is suspended as shown in Fig. 2, so as to be free to oscillate in its plane of symmetry. Since the airplane is now suspended from a point, some method should be used to level the cables as shown in Fig. 5 should be used when the cables are drawn together, in order to eliminate previous.

The airplane is now free to oscillate about its axis parallel to its y-axis. The observations required are the same as those

already given. The moment of inertia about the y-axis is computed from the formulas (2) and (3).

(c) *About z-axis*—The same suspension shown in Fig. 5 with the exception of the auxiliary wires is used for this determination. This suspension, as may be observed, puts the airplane to oscillate freely about the z-axis after it is set in motion.

Then if x = distance in ft. from z-axis to supporting cable,
 l = length of cable in ft. from axis of suspension to points of attachment

$$K = \frac{2lx}{\pi n \sqrt{g}} \quad (3)$$

$$I = K' W \quad (4)$$



Fig. 5

Results of an Experiment—The following tabulated results were obtained by the methods outlined for an American-made two-plane reconnaissance airplane, of 30 ft. span and weighing fully loaded, for six heavy flight, 2000 lb.

(a) About x-axis,	
K_x (lb. ft.)	75,296.9
K_x (ft.)	4.30
(b) About y-axis,	
K_y (lb. ft.)	63,696.4
K_y (ft.)	4.25
(c) About z-axis,	
K_z (lb. ft.)	151,000.7
K_z (ft.)	7.30

Formulas for Approximate Calculation of Brake Ho Power of Airplane Engines

By Adolph Black

Several formulas are in use at present for the approximate calculation of brake horsepower of gasoline engines but, at the exception of the old "plan" formula of the same name, none of them would appear to be of any value when applied to airplane engines. Thus, of course, with the "plan" formula it is necessary to assume a mean effective pressure which is not the actual mean effective pressure. As this, as a figure used must be modified to give the result in brake horsepower.

The formula of the American Power Boat Association into consideration most of the factors directly and indirectly which, in some of the most dependent upon the type of engine, two or four cycle. These formulas, which, it will be noted, are based on the "plan" formula, are:

B = bore in inches, S = stroke in inches, N = number of cylinders, R = number of r.p.m.

$$B.h.p. (two cycle) = \frac{B^2 \times S \times R}{12,000} \quad B.h.p. (four cycle) = \frac{B^2 \times S \times R}{24,000}$$

In the form given there are of no value in estimating the power of airplane engines, but it would appear that modifications would be made in the constants, which would only these formulas into a form in which they could be applied with approximate accuracy to this type of engine.

With this object in view constants were calculated for the performance of some of the leading American engines of the recent vintage. None of the data on these engines given on account of possible objection to publication at this time. These results give an average constant of 18,250 for two cycle engines within limits of 15 per cent above and 70 per cent below, the average.

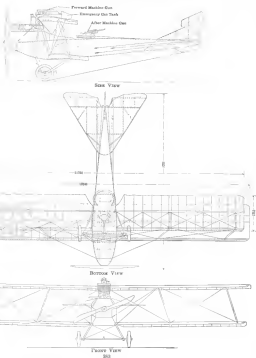
It would therefore appear that the brake horsepower of the plane engines is given with approximate accuracy by the formula:

$$\frac{B^2 \times S \times R}{18,250}$$

Detail Drawings of an Austrian Albatros Biplane

Hansa-Brandenburg Type, 200 HP. Warchlowski Engine

(Dimensions in Meters)



Front View

International Aircraft Standards



Wing Section



Fuselage



Lower Wing Spar Frame



Wing Spar Frame



Main Spar, with RAY



CARRIAGE



Wing Spar Frame



Wing Spar Frame

The International Aircraft Standards Board, which since the end of July has been holding meetings at the Bureau of Standards, Washington, D. C., for the purpose of standardizing aircraft material specifications for purchases of the Allied Governments in this country, has commenced to issue the "International Aircraft Standards" that have been adopted by the Board, of which Frank G. Dally is chairman and Dr. P. M. Mason is secretary, is also composed of representatives of the aircraft departments of Great Britain (Canada),

France and Italy, and of the Royal Corps of the Army and the Bureau of Construction of the Navy of the United States.

It has endeavored to standardize the materials entering into aircraft construction in such a manner as to conform with American practices as far as possible and at the same time to be of the greatest service to our Allies making purchases in this country. It will be noted that both the English and metric systems are used throughout these specifications.

The specifications that are now available follow:

Definition of International Aircraft Standards

General Principles of I. A. S. B.

Specifications

The specifications provide special material

specifications in the following classification:

Section 1. General material and testing methods.

Section 2. Ferrous materials, steel, light alloys, etc.

Section 3. Ferrous materials, steel, light alloys, etc.

Section 4. General material and testing methods.

Section 5. General material and testing methods.

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Section 103. General material and testing methods.

Section 104. General material and testing methods.

Section 105. General material and testing methods.

of irregularly shaped parts (cast), for which no standard dimensions are specified, shall be taken from both the finished and the unfinished surfaces. Surface defects shall be checked.

REMARKS.—(1) The materials shall be manufactured according to the best current practice.

(2) Parts shall be manufactured or as best obtained by the most recent electric furnace or electric process unless otherwise stated.

(3) A sufficient amount shall be made from each heat to secure freedom from piped and scale inclusions.

(4) The materials from which bars or forgings are made are to be rough turned or machined to remove all surface defects where high strength means are indicated by or fording. No concentration in slapping will be allowed.

First Treatment.—(1) The manufacturer shall show the best treatment recommended for the material in the specifications for all cases which are to be used in the heat-treated condition.

REMARKS.—(2) The materials shall be delivered in a workable manner and must be free from all surface and other defects to which they are subject.

(3) Any article may be rejected because of important defects or liable to manufacture or use, notwithstanding that it has previously passed the physical and chemical tests, it shall be returned to the manufacturer at the latter's expense. This clause does not apply to materials fabricated after receipt.

REMARKS.—(4) The manufacturer shall be responsible for the quality of the material in the finished condition, which are to be used in the heat-treated condition. The manufacturer must submit the longer (the testing machine are at all times).

Yield Point.—(1) The tolerance whether a specimen has a yield point must be as specified in the specifications for the material. A line shall be drawn on the test piece with a pencil about 2 in. (50 mm) in length, the specimen shall then be applied to the testing machine and a reading taken from the scale on the test piece. If the yield point is not observed, the specimen shall be discarded. If the yield point is observed, it shall be considered that the specimen has not passed the yield point test. If the manufacturer desires the yield point may be determined by an optical or microscopic method.

(2) The elastic or proportional limit, when called for, shall be determined with an extensometer loaded to at least 0.002 in. (0.05 mm). It shall be attached to the specimen at the gauge marks and to the shoulders of the specimen over an area of the tested section. The gauge mark shall be in the center of the specimen and shall not produce a permanent set. The

* The enormous percentages of air transport and their rates of 100,000 airplanes have made a good many people sceptical as to American participation in the air lighting. But behind all that talk is already a vast accomplishment. The world fleet has been built up by air air power, backed by practically inexhaustible man-power and machine-power. Its fruits will be shown as suddenly as came conscription. The situation is going to be as rapidly as possible, having regard to the enormous international air traffic, and the fact that the world has been a complete hush with the air services of France and England. The world is the latest French and English air



Two Barnish Animals
 (1) Didymos & Eudymos British Official Photo

Captain Ball's sister—That Captain Ball, V.C., R.F.C., was not killed by the German attack aviator Baron von Richthofen, but by his younger brother, is asserted by the *Forward* in its book, "The Red Battle Flyer," in which Captain Ball's death is described as follows:

"My brother's tenth-second advocate was the famous Captain Cook, by far the best English flying man. The equally well known Major Hawker I had already taken to my bosom some months earlier. It gave me approval too, that it should be my brother's luck to down the second of England's champions."

* Captain Ball was flying a triplane, and encountered my brother alone at the front. Each was tried to grasp the other, and neither exposed any vulnerable part. It proved a brief encounter. Neither of the two succeeded in getting behind the other.

² Suddenly within the brief moment of mutual frontal attack both managed to fire some well-aimed shots. Both flew at one another, both fired. Each had an engine before him, and the chances of a hit were very slender, the speed being double as great as the normal. There was really little probability of either hitting the other.

² My brother, who was somewhat heavier, had backed his machine too much and he lost his balance. For a few moments his machine was beyond control. Very soon, however, he regained command, but found that his opponent had shot both his patrol tanks to pieces. To land was, therefore, the only re-
sult.

"Quickly! Out with the plug, or the body will burn! The next thought was, What was to become of my opponent? At the moment of casting he had observed how the enemy stood untroubled aside. He could, therefore, not be very far from him. The question arose: Is he over or under me? He was below. His hands are the treacherous swimming arms, and he is

"Much adversity had in the brief moment of their encounter hit each other with their powerful machine guns, and Captain Ball had received a shot in his head. He had on his magnificent armor, and magnificent courage. From his horse, he

"During Bartlett's time, Captain Hall had charged thirty 'K' Germans into his jail. Now, he had met the mother and said it a coincidence that a great one such as he should die at the usual time of death." Captain Hall was without doubt the leader of the anti-Britishers squad, and I believe that now the Englishmen will prefer to abstain from trying to catch me. I am sorry for this, because thereby we are robbed of many a fine opportunity for getting the English a jolly denouncing. Had not my brother been wounded, I believe I could have been a great success. I have been granted to visit with Mrs. Mrs. Englishman in his cell."

Expos. American (Mailed), August 30, 1921

On Aerial Warfare:—The Germans are employing the Zeppelin type of aircraft for this purpose, namely, aerial reconnaissance in conjunction with first attacks and for defense operations, the latter chiefly against the British fleet. With highly efficient in the pursuit of the first named object, the Zeppelin has proved much less satisfactory in bombing operations.

For offensive purposes the Russians use the granite-type Zeppelins type of 30,000 cu. ft. volume, which has an endurance of 4000, a speed of 1000 ft. per hour and carries four quick-firing guns, two machine guns and four tons of explosives.

Native seed-eating passer—larkspur. It has been attacked with a smaller-seeding type of Zeppelia which has a volume of only 0.0080 cu. in., a speed of 1000 ft. miles per hour, and carries two quark firing guns, six machine guns and two tons of explosives.

(The quote) "young guns" was supposed to refer to the anti-matter guns of 1/2 at base at which three were found to be mounted on the Z-7, a Zeppelin which was brought down to England last fall by Apollo as before. — Murray.)

Pring (London), September 3, 1912

The *Handbook of the Wind*—The Times correspondent in the Western front writes Mr. Lanchester's view as to the leadership of the western winds. He says that "lightning" nearly always drifts over the eastern territory and that the Germans habitually, according to him, use more fuel on their own ground, where even a small windup only prevents them, against the adverse winds, to begin their own hunt."

The handling of the usual case deprives Allied pilots of the necessary evidence as to crashed German machines, without which their claim in return is not officially recognized. All claims are carefully examined at some three stages before they are finally admitted and published by the High Command.

probably in a number of the cases where the pains got over for having reached evening; sometimes, the rains are allowed only through the accident of some other season, flying low at the time, having seen the danger from the clouds above and the actual collision with the earth, or some similar coincidence.

Aero-Engine Induction.—With the Gnome Monosoprop engine the gasoline feed system to the carburetor may be gravity or air pressure. In a mechanical driven air pump supplying air to the main tank, or the carburetor may be supplied

Where the first system is used the fuel flows direct from the tank to the nozzles on the crankshaft and the gasoline tank must be a certain height above the center line of the engine.

one in order to provide the necessary lead. The air pressure system of fuel supply allows the tank to be placed in its convenient position and the gasifier is supplied to the jet residual pressure. A hand-operated air pump is fitted to maintain the initial pressure in the tank and the air pressure is maintained by a pressure-reducing valve.

gives the crew a variable amount of pressure when the engine is running. An adjustable automatic relief valve is used and this can be regulated to give a constant pressure of 60 lb. The tank, also, it may be adjustable during flight to correct the pressure to compensate for any difference in the atmospheric pressure.

In cases where the gasoline tank is placed above the main line of the engine, the latter can be started by allowing sufficient gasoline to flow into the carburetor by gravity, but in any other position of the tank a small auxiliary hand pump

required and connected in parallel with the main pump pump. One or two strokes of this hand pump will shut in required for priming the engine sufficiently for 3000 rpm.

News of the Fortnight

George O. Squier Made Major-General
Brig. Gen. George O. Squier, Chief Signal Officer, U. S. A.
was promoted on Oct. 5 to be a major-general.

General Sayer was born in Berlin, Mich., on March 21, 1885. He graduated from West Point in 1907 and was made a second lieutenant in the Third Artillery. He became a first lieutenant on June 30, 1909, and was commissioned a captain on June 30, 1912, and was commissioned a major on May 20, 1916. After having served through the war with Spain.

Great Britain, to which he was elected in recognition of his work in perfecting wave-wave telegraphy whereby the efficiency of submarine cables was increased from 50 to 500 per cent.

Patent Pooling Agreement Upheld

Attorney-General Gregory has ruled that the patent pooling scheme in the agreement between the Aircraft Products Board and the Manufacturers' Aircraft Association, which is to prevent patent litigation, does not violate the Sherman and Clayton laws.

This ruling clears away a possibly serious obstacle in the path of the aircraft program of the Government. The effect of the opinion is to ratify all the work done by the Aeronautics Production Board and the Advisory Committee for Aeronautics, and insures the employment of the entire surplus production capacity of the aviation industry.

In general terms, the agreement provides for the pooling in the Manufacturers' Aircraft Association of the basic airplane patents known as the Wright and Curtiss patents, as also of all other airplane patents now held or hereafter developed by members of the Association. The organization is open to any builder or patentee on payment of nominal association fees.

Payments are made for royalty payments of \$200 a machine a reduction to about one-fifth of the sum asked by patent holders before the scheme was worked out. With the savings of \$30 assigned to England, the Association, the royalties go to holders of outstanding patents. A maximum limit of \$1,000,000 is fixed, however, for each of the Wright and Curtiss claims. Holders of any future controlling patents who are members of the Association will share in royalties on later inventions.

Proposed Accounting Sheet

The Second Pan-American Aeronautics Exposition is being advertised to be held at the Grand Central Palace, New York City, Feb. 24 to 28, notwithstanding that the Aircraft Production Board recently passed the following resolution in regard to holding an aeronautical exposition during the war:

RESOLVED, that as a matter of general policy, in view of the military situation, the Board does not encourage the building of new apparatuses of armaments for the duration of the war, that for military reasons no developments of new types of engines or planes can be exhibited, and the inevitable destruction of interest on the part of the manufacturers will so be in the interests of the military departments.

There has been no change in the policy of the Government in regard to holding an exposition this year, and the above resolution is still in force.

The Manufacturers' Aircraft Association has, it is stated, given no encouragement to the holding of an exposition the year, in view of the war and the Government's expressed wishes in the matter. If other conditions prevailed under which an aeronautical show would be desirable this year, it is understood that the policy of the Manufacturers' Aircraft Association would be to conduct the show under these conditions.

National Advisory Commission Elections

At the annual meeting of the National Advisory Committee for Aeronautics held recently Dr. W. F. Durand was re-elected chairman and Dr. S. W. Stratton was re-elected secretary. Members of the executive committee were elected as follows: Dr. Joseph S. Ames, Dr. Charles F. Marvin, Dr. Michael I. Pupin, Maj. Gen. George O. Squier, United States Army, Dr. S. W. Stratton, Rear Admiral D. W. Taylor, United States Navy, and Dr. Charles D. Walcott.

At the organizational meeting of the executive committee Dr. Charles D. Walcott was elected chairman and Dr. S. W. Stratton, secretary. Working subcommittees with customers and an editorial committee was appointed to prepare for publication the technical reports.

Aviation Section News in New House

During the past week the various branches of the Aviation Section, Signal Corps, with the exception of the Photographic Branch, that were located in the Mills Building, Washington, D. C., moved into the old Southern Railway Building on E Street, N. E., near the Union Station.

Maj.-Gen. Goethals Heads Wright-Martin

On Oct. 2 Maj.-Gen. Goethals was named president of the Wright-Martin Aircraft Corp. He will take an active part in directing the corporation's affairs in an advisory capacity.

Since his retirement as general manager of the Shipping Board, General Goethals has been engaged chiefly in undertakings of his engineering firm, Goethals, Jones, & Associates, Inc., 49 Wall Street, New York.

General Goethals's election as a Director of the Wright-Martin Corp. occurred at the annual meeting of shareholders.



MAJ.-GEN. GEORGE W. GOETHALS

U.S. Colonel and Engineer.
When the other directors decided to make him president, he accepted with this statement:

"I have seriously considered and discussed my acceptance of the position to which you have elected me, and I have accepted it with the view of doing some work that will be useful and sound in the promotion of the war. My acceptance is from a sense of duty, and for such time as I can be helpful, or during the war period."

George B. Hanson, a partner of General Goethals, is to continue as vice-president and general manager of the Wright-Martin Corp. Marshall C. Dodge, of Detroit, Goethals & Co., was elected a director and the retiring members were re-elected for another year.

The Wright-Martin Corp. recently obtained a large order from the Government for Hispano-Suiza engine engines. The output of the Wright-Martin plant at New Brunswick, N. J., is to supplement the Government's production of Liberty engines to equip the airplanes now in process of construction. The company a year ago engaged to build 400 Hispano-Suiza engines, in part for the French Government, and is still at work upon them.

The annual statement says that as soon as the list of the engines shall be completed, which will be in a few weeks, the full plant capacity is to be devoted to United States Government work.

General Goethals's achievement as the builder of the Panama Canal is known and recognized throughout the civilized world. He was appointed a member of the Isthmian Canal Commission March 4, 1907, by President Roosevelt. He arrived on

the Isthmus March 12 following, and on April 1 the President placed him in complete charge of the work as Chief Engineer and Chairman of the Isthmian Canal Commission.

From that date the dirt began to fly. Completing the way ahead of all schedules and far ahead of all estimates under the estimate of \$172,500,000, on April 5, 1914, the civil construction organization went out of existence and General Goethals was made the first Governor of the Panama Canal Zone.

Although General Goethals is a great engineer, it is recognized that his achievement at Panama was mainly due to his wonderful executive and administrative ability in creating and speeding up an organization which at its zenith numbered nearly 30,000 men. The spirit de corps which he inspired in the workers and their determination to get the job done was merely a reflection of the General's own personality.

Goethals's administration was known as a benevolent autocracy, with underlying justice for officials or laborers. His Friday morning "council" was one of the institutions of the Isthmus, where he personally heard the disgruntled laborer or high official, settled personal and even family differences, administered discipline, heard suggestions for betterments and acted on them—all.

And these Friday meetings throughout his administration were at the expense of the rest and recreation of a man who was considered the hardest worker on the canal.

Impatient of the inefficiency of divided executive and responsibility where a big job is to be accomplished, the General's opinion that "Bureaus are large, narrow and wooden" is an excellent advice to a big, kind, and brilliant soldier, engineer and administrator.

Maj.-Gen. Goethals received his training as an officer in the Engineer Corps of the United States Army. He was born in Brooklyn, N. Y., June 20, 1858. He was graduated from West Point in 1880, being commissioned a Second Lieutenant of Engineers June 14, 1880. His first assignment came in 1886, and he was promoted to captain Dec. 14, 1901. During the Spanish-American War he served as Chief of Engineers in the volunteer army, with the rank of lieutenant-colonel. He was promoted to his present rank in the Regular Corps Feb. 2, 1906, March 2, 1907, to lieutenant-colonel, and Dec. 1, 1909, to colonel.

By special Act of Congress, Colonel Goethals, in recognition of his exceptional services on the Panama Canal, was advanced to the rank of major-general March 4, 1915.

The Signal Corps Waste Leaves

The Chief Signal Officer requests that the widest publicity possible be given the following appeal.

People of the United States are asked to help the Signal Corps of the Army get leaves enough to cover the loss of observation airplanes now being built. The need is immediate and of great importance. The airplanes are the eyes of the army and the camera lenses are the pupils of those eyes.

German leaves can no longer be bought in the open market. England cut this difficulty, in the early stages of the war, by means of new weapons to replace leaves and requesting these needed. England is now giving leaves better than the German was formerly supposed but no faster than could be for her own use. The Bureau of Statistics of the United States Department of Commerce is now perfecting a substitute for the German "cross leaves" plan used for leaves and will later be able to meet the needs, and special leaves or leaves designed for this work.

The situation now, however, is that, with airplanes and so to be ready for service, suitable leaves cannot be bought. Therefore, leaves are needed at once. Persons of the present type are urged to make their leaves to the Army. They are asked immediately to notify the Headquarters Division of the Signal Corps, 1 S. A. M. Building Annex, Washington, D. C., of the names of the following descriptions which they are willing to sell, stating price asked:

Tenure Antiquary Leaves, made by Carl Zeiss, Jena, of a working aperture of F. 2.5 or F. 4.5, lens 8 1/2 to 20 in. focal length.

Bausch & Lomb Zeiss Tessars, F. 4.5, from 8 1/2 to 20 in. focal length.

Vergilander Heber Assistant Leaves, F. 4.5, 4 1/2 to 24 in. focal length.

Practically all of the leaves of these types in America will be required, but the 8 1/2 in. leaves are most urgently needed.

MY SOLDIER



"A boy," said the kindly old doctor, as he fell the stair-rail. He put his arm around the man he met at the bottom, and they stood. A small cry carried down to them, so that in the man's eyes as he bade the old doctor. "A smart boy," said the teacher, when he got to. "A wonderful boy," said the maiden, who was from afar.

"My boy," said his Country, when the call came. "Our boy," said his mother and father, as they watched him march away to take his part in the Struggle for Freedom and Humanity.

THE AMERICAN SOLDIER GOES FORTH
BACK HIM UP WITH ALL YOUR

BUY A LIBERTY BOND



COMMITTEE OF
CURTISS AEROPLANE AND MOTOR CORP.



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**AEROPLANES, MOTORS
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The Goodyear Kite-Balloon

The kite-balloon perfected by Goodyear combines the principles of the man-lifting kite and the captive balloon.

The first was impractical because it required a strong wind.

The second was unsatisfactory because its use was limited to periods of calm.

Neither was stable, nor free enough from veering and yawing.

The Goodyear type of kite-balloon has fused the operating principles of both, selecting the best in each, so that it serves in storm and calm and furnishes a fixed, unwavering eye for artillery and fleet.

The carefully adjusted inclination of the elongated bag makes the plane of its nether surface a kite when the wind is on its front, and a resistant plane when the air currents are heavy on the back of the bag.

The refinements of keel construction, steadying side fins, and stabilizing tail-cups are Goodyear contributions to steadiness in air.

Every factor necessary to the fusion of the principles of kite and balloon has been developed or perfected—either in design or in material, or both.

*Everything in Rubber for Airplanes
Balloons of Any Size and Every Type*

The Goodyear Tire & Rubber Company, Akron, Ohio

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WAR WILL END QUICK

When Aeroplanes of Speed and Durability are put into
Service by the Allies

ALUMINUM SHEETS

Decrease Weight, Increase Speed, Strength and Durability

We carry the Largest Stock in the World—and Operate
Our Own Rolling Mills

Service is Assured—Write us Today

WE ALSO MAKE ALUMINUM INGOTS, OF ALL GRADES—FOR CASTINGS OR
STEEL PURPOSES—RODS—WIRES—GRANULES, ETC.



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CRANKSHAFT QUALITY

Stands out as the one requirement today of the builder of

AIRCRAFT AND HIGH DUTY ENGINES

Experience only can produce a product to equal these demands.

Wyman-Gordon Company for many years, in their Research, as well as their Manufacturing Departments, have been developing along the lines that make them today able, without experiment, to supply crankshafts of

UNQUESTIONED RELIABILITY

Every stage in the production of a Wyman-Gordon crankshaft is subjected to rigid inspection and tests guaranteeing a high metallurgical quality.

Behind our product is a perfect service.

Prompt attention to all orders and deliveries without delay.

WYMAN-GORDON COMPANY
WORCESTER, MASS.

"The time has come to conquer or submit."
 "For as there is but one choice. We have made it."
 —PRESIDENT WILSON.

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For

United States Government BONDS

of the

SECOND LIBERTY LOAN

\$3,000,000,000

—or more—
 (Let's make it more!)

These new United States Government Bonds are issued in denominations of \$50 and multiples thereof. The United States Treasury will pay you interest at 4% per annum, payable semi-annually.

EASY PAYMENTS—You can pay 2% on your bonds when you make your application. 18% November 15, 40% December 15, and 40% January 15, 1918. For example, when you buy a \$100 bond you can pay \$2 now, \$18 November 15, \$40 December 15, and \$40 January 15. **YOU CAN GET YOUR BOND AS SOON AS YOU HAVE FULLY PAID FOR IT.** Liberty bonds are the best security in the world. They are readily salable and are practically exempt from taxation for people of moderate incomes. The law permits their conversion into bonds bearing higher interest should such bonds be issued by the Government in the future.

**HELP YOUR COUNTRY AND YOURSELF
 HELP OUR BOYS "OVER THERE"**

Get an official Liberty Loan blank from any Bank or Trust Company and

SUBSCRIBE NOW

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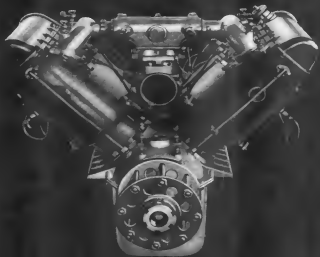
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